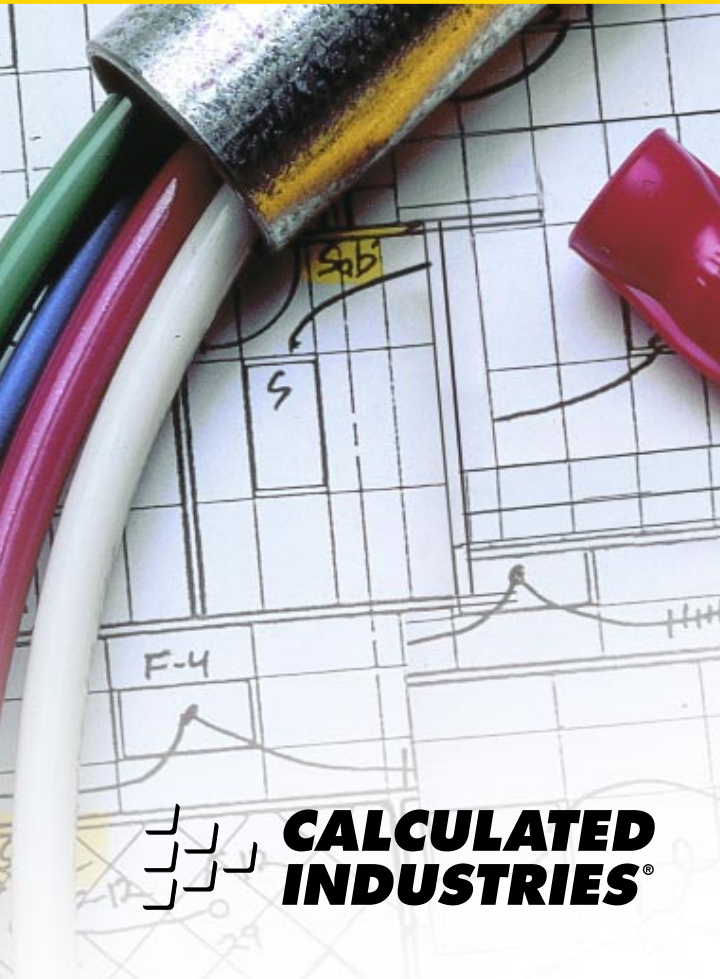
ElectriCalc® Pro

NEC® COMPLIANT
UPDATEABLE ELECTRICAL CODE CALCULATOR

Model 5065

User's Guide



CALCULATED INDUSTRIES®

Introducing the

ElectriCalc® Pro

Now NEC®-Updateable!

The *ElectriCalc® Pro* is an invaluable calculator for today's busy electrical professional. Unlike a regular calculator, it has intuitively labeled "electrical keys" and conforms to the 2005 (and 2002, 1999, 1996) and future *National Electrical Codes*, allowing you to solve Code-related problems quickly and accurately. The most common NEC tables are now at your fingertips!

An important feature of the *ElectriCalc Pro* is that it is programmed to accept future NEC changes, allowing you to conveniently install future Code editions in a few simple steps.

The *ElectriCalc Pro* instantly solves for the following:

- *Kirchhoff's Law*
- *Ohm's Law*
- *Volts, Amps, Volt-Amps, Watts, kVA, kW, PF%, EFF%, and Resistance*
- *Copper or Aluminum Wire Sizes*
- *Parallel and Derated Wire Sizes*
- *Voltage Drop Wire Sizes, % and Actual Voltage Drops, Voltage Drop Distances and Wire Resistances*
- *Kilowatt hours and BTU's*
- *Parallel Resistance*
- *Grounding Conductors Sizes*
- *Motor Full-Load Amps*
- *Overload Protection Sizes*
- *NEMA Starter Sizes*
- *Conduit Sizes*
- *And much more!*

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Your *ElectriCalc Pro* is now updateable for future National Electrical Code® editions that are updated every three (3) years. To upgrade your unit, follow the instructions below:

1) Purchase the NEC Update from CI (see pricing / details from CI's Web site: www.calculated.com or call 1-800-854-8075). This Update is in the form of a chip that contains the new Code.

2) Once you receive the NEC Update chip, you need to install it in your ElectriCalc Pro:

   a) Turn calculator off.

   b) As a precaution, remove the battery (located back of calculator, top of unit) by sliding battery door out with your thumbnail. Set aside.

   c) Using a screwdriver, pop out the square tab located in the middle section on the back of your calculator.

   d) Replace it with the new update tab by inserting it into the slot.

   e) Replace the battery door.

   f) Turn calculator on. Your calculator is now updated and ready to use.

Key Definitions

Standard Calculator Functions

On/C — ***On/Clear***
Turns on power. Pressing once clears the last entry and the display. Pressing twice clears all non-permanent values.

Off — ***Off***
Turns all power off. Clears the Memory and most internal registers.

+ − × ÷ =
Arithmetic operation keys.

0 1 2 3 4 5 6 7 8 9 •
Used for keying in numbers.

% — ***Percent***
Four function (+,-,x,÷) Percent key.

Set VD% — ***Reciprocal (1/x)***
Finds the reciprocal of a number (e.g., **8 Set VD%** 0.125).

← — ***Back Space Function***
Used to delete entries one keystroke at a time (unlike the **On/C** function, which deletes the entire entry).

Set — ***Second Function***
Used with other keys to access secondary functions.

Stor — ***Store***
Used with function keys to store values.
Displays: STOR

Rcl ***— Recall***
Recalls a value stored in a register (e.g., to recall voltage drop % press **Rcl** **VD%**).
Displays: RCL

Set **+** ***— Pi (π)***
Constant = 3.1415927

Set **−** ***— Change Sign (+/–)***
Toggles the sign of the displayed value from positive to negative or from negative to positive.

Set **%** ***— x^2***
Squares the displayed value.

Set **←** ***— Square Root ($\sqrt{x}$)***
Square Root function.

Stor **0** ***— Cumulative Memory (M+)***
Adds displayed value to Memory (e.g., 1 0 **Stor** 0, 2 0 **Stor** 0, **Rcl** 0 = 30). To subtract from Memory, you must add a negative value to the cumulative Memory (e.g.,1 0 **Stor** 0, 5 **Set** − **Stor** 0, **Rcl** 0 = 5). Clears when the calculator is shut off.

Rcl **0** ***— Memory Recall***
Displays the value saved in (*M+*).

Rcl **Rcl** ***— Display/Clear Memory (M-R/C)***
Displays and clears the value saved in (*M+*).

Set **Rcl** ***— Clear Memory***
Clears the value saved in (*M+*) without changing displayed value.

2 — ElectriCalc Pro

Stor 1 - 9 — ***Memory Storage***
When pressed after the **Stor** key, the 1 through 9 keys will store the displayed values into non-cumulative Memory.

Rcl 1 - 9
Recall M1 – M9.

Mode Set-up Functions

Set **X** — ***Clear All***
Clears all values, including Memory. Resets settings to default values, except preference settings which are retained.

Set ÷ — ***Preferences (Prefs)***
Use to set default settings or modes (see “Preference Settings”).

Set 1 — ***Single-Phase (1Ø)***
Sets calculator to single-phase mode. **Displays: 1Ø**

Set 3 — ***Three-Phase (3Ø)***
Sets calculator to three-phase mode. This is the default setting. **Displays: 3Ø**

Set 2 — ***Ambient Temperature (AMB°)***
Permanently enters ambient temperature for determining ampacity derived wire sizes. Ambient temperature will only change when entering a new value or by resetting the calculator. Defaults to 30°C (86°F). **Amb** will display when the ambient temperature is other than 30°C (86°F). **Displays: AMB°**

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NOTE: *The temperature units can be displayed in Celsius (°C) or Fahrenheit (°F) by using the preference function* **Set** ÷.

Set 4 ***— Copper/Aluminum (Cu/Al)***
Used to toggle between copper (default) and aluminum wire types. When the wire type is revised, any calculated wire size will be re-calculated automatically. If a wire size is entered with the wrong wire type, pressing **Set** 4 will change the material type without changing the size. **Displays: Al or Cu**

Set 5 ***— Free Air (FrAir)***
Sets calculator into Free Air mode, which refers to NEC Table 310-17 for wire size calculations. **Displays: FrAir**

Set 6 ***— 60°C Wire Insulation***
Sets calculator to 60°C wire insulation type for wire size calculations. This is the default setting. **Displays: 60**

Set 7 ***— 75°C Wire Insulation***
Sets calculator to 75°C insulation type for wire size calculations. **Displays: 75**

Set 9 ***— 90°C Wire Insulation***
Sets calculator to 90°C insulation type for wire size calculations. **Displays: 90**

Electrical Functions

kilo- — ***kilo-***
This key is used with Watts, Amps, Volts, and Volt-amps keys to identify "kilo-" values.

Set **kilo-** — ***milli-***
This key sequence is used with Watts, Amps, Volts, and Volt-amps keys to identify "milli-" values.

Amps — ***Amps***
Enters or calculates Amps (using Volts and VA or Watts). **Displays: AMPS, KAMP or mAMP**

Volts — ***Volts***
Enters or calculates Volts (using Amps, HPth, and VA or Watts). Default value is 240 Volts. **Displays: VOLT, KV, or mV**

VA — ***Volt-Amps***
Enters or calculates Volt-amps (using Amps, Volts and Horsepower or Watts). **Displays: VA, KVA, or mVA**

Watts — ***Watts***
Enters or calculates Watts (using Amps, Volts, and VA or Horsepower).
Displays: WATT, KW, or mW

Set **Amps** — ***DC Amps (Idc)***
Enters or calculates DC Amps (using DC Volts and Resistance). **Displays: Idc**

Set **Volts** ***— DC Volts (Vdc)***
Enters or calculates DC Volts (using DC Amps and Resistance). **Displays: Vdc**

Set **VA** ***— DC Resistance (R)***
Calculates and displays DC resistance in Ohms (using DC Volts and DC Amps). **Displays: R**

Set **Watts** ***— Power Factor (PF%)***
Enters or calculates power factor percentage (based on Watts and VA). Defaults to 100%. Entered or calculated power factors greater than 100% will result in an error. **Displays: PF%**

HPth ***— Horsepower (Theoretical)***
Enters or calculates theoretical Horsepower (based on Amps, VA, Watts, efficiency%, PF%, and/or Volts). 1.0 HPth correlates to 746 Watts at 100% efficiency. **Displays: HPth**

Set **HPth** ***— Efficiency (Eff%)***
Enters or calculates the percent ratio between real power (Watts) and theoretical Horsepower. Default: 100%. Entered or calculated efficiencies greater than 100% will result in an error.
Displays: EFF%

Set **●** ***— Kilowatt–Hours to BTU (Kw-hr ▸ Btu)*** Calculate BTU (British Thermal Unit) based on an entered Kilowatt-Hour value. **Displays: KW-H**

Set **=** ***— BTU to Kilowatt–Hours (Btu ▸ Kw-hr)*** Calculate Kilowatt-Hours based on an entered BTU (British Thermal Unit) value. **Displays: BTU**

Set **Stor** ***— Parallel Resistance (Par Res)*** Calculate total resistance based on an entered series of resistance values. **Displays: P-RS**

Motor Horsepower Functions

The *ElectriCalc Pro* can be used to determine motor full-load current (Amps) based on entries for motor Horsepower (HPmotor), Phase and Voltage.

You can also find an equivalent motor Horsepower if you have entered Voltage and full load current values. Only HP motor and Voltage entries as defined by NEC Tables 430-247, 430-248 and 430-250 can be used to determine motor loads.

Set **8** ***— Induction/Synchronous/DC Motor Toggle (Ind/Sync/DC)*** Toggles between induction, synchronous, and direct current motor types. **Displays: IND** (induction - default), **SYNC** (synchronous) or **DC** (direct current).

HPmotor ***— Motor Horsepower*** Enters or calculates motor Horsepower. **Displays: IND HP** (induction – default), **SYNC HP** (synchronous) or **DC HP** (direct current).

Ampacity Tables

The *ElectriCalc Pro* uses NEC Table 310-16 (310-17 for Free Air) to find wire sizes and ampacity ratings of wires. The calculator uses the following data to calculate wire size: 1) insulation temperature rating (60°C, 75°C and 90°C); 2) wire material (copper or aluminum); and 3) ambient temperature. Standard AWG wire sizes and Circular Mils are used by the *ElectriCalc Pro*. Wire size entries less than or equal to 2000 are accepted as AWG wire sizes; entries greater than 2000 are accepted as Circular Mil entries and display the corresponding AWG wire size. Entries must match the standard wire sizes or Circular Mils; otherwise, “nonE” will be displayed (Invalid entry).

NOTE: *1/0, 2/0, 3/0 and 4/0 wires are entered using the* [0] *key (e.g., 0, 00, 000 and 0000).*

WireSz ***— Wire Size/Ampacity***

Enters or calculates wire size based on ampacity and Voltage drop, if a Voltage drop length has been entered.

♦ *First Press*

If a wire length has been entered, the first press will show the larger of the ampacity or voltage drop derived wire size. The calculator will use the larger value when calculations require a wire size. If no Voltage drop length has been entered, the calculator will display the calculated ampacity rated wire size.

♦ *Second Press*
If a wire length has been entered, the second press displays the smaller of the two wire sizes. If not solving for Voltage drop wire size, then displays the maximum ampacity.

♦ *Third Press*
Displays the wire size in Circular Mils. **Displays: CMIL**

♦ *Fourth Press*
If a wire length has been entered, displays the minimum wire ampacity rating. If no wire length has been entered, displays the NEC table referenced for the calculation. **Displays: NEC 310.16**

Set WireSz — *125% Ampacity*
Used for motor wire sizing when the wire must not exceed 80% of its rated ampacity (125%A). This keystroke calculates wire size based on 125% of the entered or calculated Amps value. **Displays: 125%**

ParSz — *Parallel Size*
Used to find the size of parallel conductors using amperage and an entered quantity of wires. Parallel wire size calculations smaller than 1/0 are displayed as "none" (display shows "**nonE**") as the NEC does not allow parallel wire runs smaller than 1/0.

♦ *First Press*
When preceded by a number, calculates the applicable wire size for that quantity of wires in parallel.
Displays: PAR WIRE SIZE

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♦ *Second Press*
Displays the maximum adjusted ampacity of the calculated parallel wire size. **Displays: WIRE A**

NOTE: *No adjustments are made for deration.*

Set ParSz — *Derated Wire Size (D/R Size)*
Used to calculate derated wire sizes and allowable ampacity based on the entered quantity of wires, NEC Table 310-16 and NEC Table 310-15(b)(2)(a). Derated wire sizes are not calculated when there are less than four wires, or when the unit is in Free Air mode.

♦ *First Press*
Calculates the derated wire size, if you have entered the number of wires, for example, 4 **Set ParSz**
Displays: D/R WIRE SIZE

♦ *Second Press*
Displays the maximum adjusted ampacity of the derated wire size.
Displays: D/R WIRE A

♦ *Third Press*
Displays the derated adjustment factor per the NEC Table 310-15(b)(2)(a). **Displays: ADJ %**

♦ *Fourth Press*
Displays the NEC table referenced for the calculation. **Displays: NEC 310.15**

Voltage Drop Solutions

The *ElectriCalc Pro* will calculate maximum lengths, minimum wire sizes or actual voltage drops given the other two values. Voltage drop solutions are based on the DC resistance values found in NEC Chapter 9, Table 8.

NOTE: *Voltage drop solutions may vary slightly from actual AC circuit values as the calculator does not incorporate factors such as inductive reactance, skin effect, raceway material, etc.*

VD% ***— Percent Voltage Drop***

Used to enter or calculate voltage drop. The default voltage drop is 3%. If wire size or wire length values are not available, "**nonE**" will display since the voltage drop cannot be found.

♦ *First Press*

Enters a maximum allowable voltage drop percentage (**Displays: V DROP %**) or calculates actual Voltage drop (**Displays: V DROP**).

♦ *Second Press*

Calculates actual percent Voltage drop. **Displays: V DROP %**

Length ***— Length***

Enters or calculates the length of a run for Voltage drop calculation.
Displays: FEET or MET

NOTE: *Units of length can be set to Feet or Meters by use of the Preference function* **Set** ÷.

Set **Length** — ***Wire Resistance (Wire Res)***

Displays the actual resistance per 1,000 feet of the wire size in **WireSz** based on NEC Chapter 9, Table 8.

Displays: OHMS WIRE

Ground Function Keys

Grnd — ***Ground***

An output-only key used to find the grounding electrode conductor size for AC systems based on NEC Table 250-66 and an entered or calculated service-entrance conductor (largest size). Only actual wire sizes are considered valid entries.

♦ *First Press*

Calculates the copper grounding electrode conductor size if you have entered a valid wire size.

Displays: GRND CU WIRE SIZE

♦ *Second Press*

Displays the aluminum grounding electrode conductor size.

Displays: GRND AL WIRE SIZE

♦ *Third Press*

Displays the Circular Mil area used to calculate the grounding electrode conductor size. **Displays: CMIL WIRE**

♦ *Fourth Press*

Displays the NEC table referenced for the calculation. **Displays: NEC 250.66**

Set Grnd — *Equipment Ground (EqGrnd)*

This function uses NEC Table 250-122 to calculate the minimum equipment grounding conductor size, given an entered amperage rating or setting for a over-current device up line (e.g., 300 Set Grnd).

NOTE: *This function deviates from the NEC Table 250-122 in that 1250 MCM AL is used instead of 1200 as specified in NEC Table 250-122.*

♦ *First Press*

Displays the copper grounding conductor size for the entered Amp rating. **Displays: EQPG WIRE SIZE CU**

♦ *Second Press*

Displays the aluminum grounding conductor size. **Displays: EQPG WIRE SIZE AL**

♦ *Third Press*

Displays the NEC table referenced for the calculation. **Displays: NEC 250.122**

Fuse/Breaker Keys

The *ElectriCalc Pro* has special keys that automatically calculate the Amp ratings of the following over-current protection devices: Dual Element Fuses (Time Delay), Single Element Fuses (Non-Time Delay), Instantaneous Trip Breakers (Type 1), Inverse Time Breakers (Type 2), and Overload Protection Devices.

These fuse and circuit breaker sizes are derived using the "Percent of Full-Load Current" multipliers listed in NEC Table 430-52.

You can also calculate the full Voltage starter size for non-plugging and non-jogging duty motors based on phase, Voltage, motor HP and NEMA table specifications.

If a parameter is missing or invalid, the calculator will display "**nonE**."

Set **O-Load** ***— Motor Type (M-Type)***
Based on NEC Table 430-52, this key selects the motor type used to define the percent factors for breakers/fuses. Once set, the motor type remains fixed until you change it or perform a Clear All (**Set** **X**).

♦ *First Press*
Displays the current motor type. Note there is no motor type in single-phase mode.

♦ *Second Press*

In three-phase mode only, subsequent presses of O-Load will select and display the next motor type from this list: **SQ-C non-B** (Squirrel Cage, non-Design B), **SQ-C B** (Squirrel Cage, Design B), **SYNC no codE** (Synchronous), **WND no codE** (Wound Rotor).

DEFuse — *Dual Element Fuse*

♦ *First Press*

Calculates the minimum Amp rating for a Dual Element Fuse.
Displays: AMPS dE.

♦ *Second Press*

Displays the full-load current percent multiplier used to determine fuse size.
Displays: %FLC

Set DEFuse — *Single Element Fuse (SEFuse)*

♦ *First Press*

Displays the minimum Amp rating based on Phase, motor type, and amperage.
Displays: AMPS SE

♦ *Second Press*

Displays the full-load current percent multiplier value used to determine fuse size. Subsequent presses repeat this cycle. **Displays: %FLC**

Set InvTime — *Instantaneous Trip Circuit Breaker (InsTrip)*

♦ *First Press*
Displays the minimum Amp rating for an Instantaneous Trip Circuit Breaker, based on the phase, motor type, and amperage. **Displays: AMPS b1**

♦ *Second Press*
Displays the full-load current percent multiplier value used to determine breaker size. **Displays: %FLC**

InvTime — *Inverse Time Breaker*

♦ *First Press*
Calculates the minimum Amp rating for an Inverse Time Breaker, based on the phase, motor type, and amperage. **Displays: AMPS b2**

♦ *Second Press*
Displays the full-load current percent multiplier value used to determine breaker size. **Displays: %FLC**

O-Load — *Overload Protection*

♦ *First Press*
Displays the overload amperage requirement based on the full-load current shown on the motor nameplate. Multiplies the entered motor nameplate full-load current (stored in the Amps registers) by 115% or the value you enter.

Conforms to NEC Section 430-32 (a)(1) value of 115% unless you enter another value. For example, entering 125 O-Load would calculate overload protection based on 125% of the entered amperage. **Displays: AMPS ol**

♦ *Second Press*
Displays the full-load current percent multiplier value used to determine the overload current protection size. Subsequent presses of O-Load repeat the cycle. **Displays: %FLC**

Set HPmotor — *Starter Size (Starter)*
Displays the starter size (from NEMA publication ICS 2-1988 Tables 2-327-1 and 2-327-2) based on the phase, Voltage, and motor Horsepower settings. **Displays: STAR SIZE**

NOTE: *Horsepower values not identified in NEMA tables will cause the calculator to round up to the next larger starter size in the table.*

Conduit Sizing Keys

The *ElectriCalc Pro* calculates conduit size using NEC Tables 1, 3, 4, and 5 of Chapter 9 (given insulation type, wire size, and quantity of wires). It will also calculate the number of wires of a specified insulation type and wire size that will fit in a defined conduit size. Acceptable conduit sizes (depending on the type of conduit used) are as follows: 1/2", 3/4", 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", 3-1/2", 4", 5", and 6". Conduit sizes are entered using decimal equivalents (e.g., 1-1/2" is entered as 1.5, 3/4" is entered as .75, etc.).

#THW #THHW, #XHH #XHHW, #THHN #THWN — *Number of Wires*
Used to enter or calculate the number of wires in a raceway and calculate cross-sectional wire area.

♦ *First Press*
Enters number of wires or calculates maximum number of wires in conduit. **Displays: TTL WIRES** (calculated) or **WIRES** (entered).

♦ *Second Press*
Shows total cross-sectional area for all entered wires. **Displays: WIRE AREA** (entered) or **TTL WIRE AREA** (calculated).

♦ *Third Press*
Shows total cross-sectional area of all entered wires of the selected wire insulation. **Displays: TTL WIRE AREA**

CondSz — *Conduit Size*

Used to find conduit sizes based on the total area of the entered wire types and sizes (up to 15 at one time). If the quantity and insulation type has not been entered, the calculator will assume 2 THHN wires for single-phase or 3 THHN wires for three-phase calculations.

♦ *First Press*

Enters or calculates conduit size. **Displays: COND SIZE**

NOTE: *If a wire size has not been entered or calculated, or an invalid conduit size is entered, the calculator will display "**nonE**."*

♦ *Second Press*

Shows total number of wires in the conduit for calculated conduit size. Shows the conduit internal area for an entered conduit. **Displays: TTL WIRES** (calculated) or **COND AREA** (entered).

NOTE: *Third through fifth presses display only for calculated conduit sizes.*

♦ *Third Press*

Shows fill percentage for the calculated conduit size as determined by Table 1, Chapter 9. **Displays: COND FILL %**

♦ *Fourth Press*

Shows the total wire area for all entered wires. **Displays: FILL TTL WIRE AREA**

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♦ *Fifth Press*

Shows remaining fill area. This value may be negative if all wires are the same size due to Note 7 in NEC Chapter 9, Table 1.

Displays: REM WIRE AREA

Set CondSz — *Conduit Type (Cond Type)*

♦ *First Press*

Displays the currently selected conduit type.

♦ *Second Press*

Subsequent presses will display and select the next conduit type from this list:

1) EMT
2) ENT
3) FMC
4) IMC
5) LFNB
6) LFNA
7) LFMC
8) RMC
9) P-80
10) P-40
11) P-A
12) P-EB

To select a specific conduit type, enter the corresponding number of the conduit and then press Set CondSz. If you press this keystroke without entering a number, the calculator will switch to the next conduit type on the list.

Preference Settings

Your calculator has the following Preference Settings that you can access and change at any time.

Access the Preference Settings by pressing Set ÷. Then, to access each category, press the ÷ key until the desired setting is reached. *Within each category*, press the + or − keys to toggle between individual selections (note: the + will advance, the − will back-up).

You can change these settings at any time by repeating the above, and setting in a new preference.

NOTE: *To return the Preferences to the default settings, perform a full reset (press Off, hold down X, and press On/C), or manually set them back using the keystrokes below.*

The Preference Settings are (default settings shown first):

To Set 2005, 2002, 1999, or 1996 NEC code:

Set ÷ *(1st press of ÷)*	**NEC 2005**
+	**NEC 1996**
+	**NEC 1999**
+	**NEC 2002**

To Set Ambient Temp. to °C or °F:

÷ *(2nd press of* ÷*)*	**AMB° 30 °C**
+	**AMB° 86 °F**

To Set Length to Feet or Meter:

÷ *(3rd press of* ÷*)*	**FEET 1.**
+	**MET 1.**

Default Settings

When you first receive your calculator, it is pre-set to the default settings listed below. You can always return your calculator to these default values by performing a Clear All (Set X).

Ambient Temperature	**30°C**
Insulation Rating	**60°C**
Material	**Copper (Cu)**
Phase	**3Ø**
Volts	**240 V**
Efficiency	**100%**
Power Factor	**100%**
Voltage Drop Percent	**3%**
Wire Environment (vs Free Air)	**Raceway**

Basic Math Operations

This calculator uses standard chaining logic, which simply means that you enter your first value, the operator (+, −, ×, ÷), the second value and then the equals sign =.

A. 3 + 2 = 5.
B. 3 − 2 = 1.
C. 3 × 2 = 6.
D. 3 ÷ 2 = 1.5

Percent Calculations

The Percent key % can be used for finding a given percentage of a number or for working add-on, discount or division percentage calculations.

3 5 5 × 1 5 %	53.25
2 5 0 + 6 • 5 %	266.25
2 5 − 5 %	23.75
1 0 0 ÷ 5 0 %	200.

The Percent key also allows you to change percentages to decimals (e.g., 2 5 % 0.25).

Memory Operations

Whenever the Stor 0 keys are pressed, the displayed value will be added to the Memory. Other Memory functions:

FUNCTION	KEYSTROKES
Add to Memory	Stor 0
Subtract from Memory	Set − Stor 0
Recall total in Memory	Rcl 0
Display/Clear Memory	Rcl Rcl
Clear Memory	Set Rcl

Memory is semi-permanent, clearing only when you:

1) turn off the calculator;
2) press Rcl Rcl;
3) press Set Rcl;
4) press Set X *(Clear All)*.

When Memory is recalled (Rcl 0), consecutive presses of Rcl 0 will display the calculated average and total count of the accumulated values.

Using M+

KEYSTROKES	DISPLAY
3 5 5 Stor 0	M+ 355. M
2 5 5 Stor 0	M+ 255. M
7 4 5 Set − Stor 0	M+ – 745. M
Rcl 0	TTL – 135. M
Rcl 0	AVG – 45. M
Rcl 0	CNT 3. M
Rcl Rcl	– 135.

Using Memory Storage Keys (M1 - M9)

In addition to the standard cumulative Memory (as previously described), your calculator has nine independent Storage Registers – M1 through M9 – that can be used to permanently store single, noncumulative values. The following example shows the use of M1 (Stor 1). To use M2 through M9, replace the presses of the 1 key with presses of the corresponding number key (2 through 9).

You can replace a value in one of these Memory registers by storing a new value in place of the stored value.

FUNCTION	KEYSTROKES
Store single value in M1	Stor 1
Clear M1	0 Stor 1
Recall M1	Rcl 1

Examples:

Store 175 into M1, recall the value, and then clear the value.

KEYSTROKES	DISPLAY
1 7 5 Stor 1	M-1 175.
Off On/C	0.
Rcl 1	M-1 175.
0 Stor 1	M-1 0.

Kirchhoff's Law

The *ElectriCalc Pro* utilizes Kirchhoff's Law in finding Volts, Amps, Volt-amps, Watts, Horsepower (theoretical), efficiency and power factor.

Finding Voltage

Find the Voltage supply to a single-phase load drawing 14,605 Volt-amps and 115 Amps.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Enter VA	1 4 6 0 5 VA	VA 14,605.
Enter Amps	1 1 5 Amps	AMPS 115.
Solve for Volts	Volts	VOLT 127.

Finding Amps

What is the current (Amps) for a load drawing 8,250 Volt-Amps on a 240 Volt, three-phase circuit?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter VA	8 2 5 0 VA	VA 8,250.
Enter Volts	2 4 0 Volts	VOLT 240.
Solve for Amps	Amps	AMPS 19.846416

Finding Current Load

A building with 120/240 Volt 1Ø service has the following loads:

Range = 7,800 VA
Heating = 15,100 VA
Dryer = 5,100 VA
Appliances = 8,900 VA
Lighting = 6,470 VA

What is the service load (Amps) of the circuit supplying this building?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Add VA loads:	7800 +	
	15100 +	
	5100 +	
	8900 +	
	6470 =	43,370.
Enter as VA	VA	VA 43,370.
Enter Volts	240 Volts	VOLT 240.
Solve for Amps	Amps	AMPS 180.70833

Finding Amps from Kilowatts

What is the amperage for a 75 kW load connected in a 120/208 Volt, 3Ø circuit?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter kilowatts	75 kilo- Watts	KW 75.
Enter Volts	208 Volts	VOLT 208.
Solve for Amps	Amps	AMPS 208.17918

Finding Volt-Amps

What is the VA rating for a 120 Volt, 22 Amp, 1Ø circuit? What is the kVA rating?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Enter Volts	1 2 0 Volts	VOLT 120.
Enter Amps	2 2 Amps	AMPS 22.
Solve Volt-amps	VA	VA 2,640.
Solve for kVA	kilo- VA	KVA 2.64

Finding kVA Rating

What is the kVA rating for a 120/208 Volt, three-phase, 65 Amp transformer?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter Volts	2 0 8 Volts	VOLT 208.
Enter Amps	6 5 Amps	AMPS 65.
Solve for kVA	kilo- VA	KVA 23.417327

Finding Wattage

A 120 Volt, single-phase, 45 Amp electrical motor has an 87% power factor. What is its wattage?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Enter Volts	1 2 0 Volts	VOLT 120.
Set power factor	8 7 Set Watts	PF% 87.
Enter Amps	4 5 Amps	AMPS 45.
Solve for Watts	Watts	WATT 4,698.

Finding kW Rating

What's the kW rating for a 90 Amp, 208 Volt, three-phase broiler with 100% power factor?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Set power factor	1 0 0 Set Watts	PF%100.
Enter Amps	9 0 Amps	AMPS 90.
Enter Volts	2 0 8 Volts	VOLT 208.
Solve for kW	kilo- Watts	KW 32.423991

Ohm's Law

The *ElectriCalc Pro's* built-in Ohm's Law functions allow you to easily solve for Voltage (Volts), current (Amps), or resistance (Ohms) by entering in any two variables (e.g, Volts and Amps) and solving for the third (e.g., Ohms).

Ohm's Law: V = I x R

The Ohm's Law functions on the *ElectriCalc Pro* are identified as follows:

- Vdc = Voltage, in Volts
- Idc = current, in Amps
- R = resistance, in Ohms

Finding Volts

The current in a circuit is 0.0125 Amps, and the total resistance is 480 Ohms. Find the Voltage.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter current	• 0 1 2 5 Set Amps	Idc 0.0125
Enter resistance	4 8 0 Set VA	OHMS 480.
Find Voltage	Set Volts	Vdc 6.

Finding Amps

An 120k electrical resistor is plugged into a 12 volt circuit. Find the current (in Amps).

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter resistance	1 2 0 kilo- Set VA	KOHM 120.
Enter Voltage	1 2 Set Volts	Vdc 12.
Find current	Set Amps	Idc 0.0001

Finding Ohms

An electrical circuit operating at 240 Volts has a current of 14.6 Amperes. Find the total resistance (in Ohms) of the circuit.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter Voltage	2 4 0 Set Volts	Vdc 240.
Enter current	1 4 • 6 Set Amps	Idc 14.6
Find resistance	Set VA	OHMS 16.438356

Motor Horsepower

The *ElectriCalc Pro* can calculate the full load current (Amps) of a motor, based on phase, Voltage and motor (synchronous, induction, or DC). It uses NEC Tables 430-247, 430-248 and 430-250 to determine the motor full load current. (If you enter a value for HP or Voltage that does not correspond to these tables, the unit will display nonE).

The *ElectriCalc Pro* can also calculate an equivalent Horsepower for an induction, synchronous or direct current motor based on a Voltage, phase and full load current. When calculating motor HP from an entered amperage, a result not directly matching a value in NEC Table 430-247, 430-248 or 430-250 will cause the calculator to choose the next higher table value for motor Horsepower.

Finding Single-Phase Full Load Current

A 2 HP induction motor operates on 230 Volt, single-phase power. What is the full load current for this motor?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Enter Volts	2 3 0 Volts	VOLT 230.
Enter HP	2 HPmotor	IND 2. HP
Find full load Amps	Amps	FLC 12. A

Finding Motor Wire Size and Ampacity

Find the wire size required to connect a continuous run, 3Ø, 3 HP induction motor into a 230V circuit.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter Volts	2 3 0 Volts	VOLT 230.
Enter HP	3 HPmotor	IND 3. HP
Find load current	Amps	FLC 9.6 A
Find 125% A size	Set WireSz	AWG 14 CU
		WIRE SIZE 125%
Find max ampacity	WireSz	14* 20.0
		WIRE A125%

**Display will show wire size in the upper left when displaying wire ampacity rating.*

Finding Synchronous Motor Horsepower

A synchronous motor is defined as having a 27 Amp load on a 240 Volt, 3Ø circuit. What is its Horsepower?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Set to synch.	Set 8	SYNC 0.
Enter Volts	2 4 0 Volts	VOLT 240.
Enter Amps	2 7 Amps	AMPS 27.
Solve for HP	HPmotor	SYNC 25. HP
Set to ind. motor	Set 8 Set 8	IND 0.

Finding Direct Current Motor Horsepower

A direct current motor is defined as having a 10 Amp load on a 180 Volt circuit. What is its horsepower?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to DC motor	Set 8 Set 8	DC 0.
Enter Volts	1 8 0 Volts	VOLT 180.
Enter Amps	1 0 Amps	AMPS 10.
Solve for HP	HPmotor	DC 2. HP
Set to ind. motor	Set 8	IND 0.

Ampacity Wire Sizing

The required wire size of a service conductor can be determined based on the specified electrical requirements and the WireSz key. The wire size is automatically recalculated whenever the wire insulation (temperature) ratings or wire material (copper or aluminum) types are revised. Wire sizing is based on the requirements defined in NEC Tables 310-16 and 310-17.

Wire Sizing Based on Insulation Rating

Wiring is being installed in a 240 Volt, single-phase system rated at 30 kVA. What is the wire size needed if you use 60°C copper wire?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Enter kVA	3 0 kilo- VA	KVA 30.
Enter Volts	2 4 0 Volts	VOLT 240.
Find Amps	Amps	AMPS 125.
Find wire size	WireSz	AWG 0 CU WIRE SIZE
Display Wire Ampacity	WireSz	0 125.0 Cu WIRE A
Display CMIL	WireSz	CMIL 105,600 WIRE
Display NEC Table	WireSz	NEC 310.16

Re-sizing Wire Based on Different Insulation Ratings

What wire size is required for a 3Ø, 75°C copper branch circuit carrying a load of 260 Amps? What would the wire size be if 90°C copper is used?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Set to 75°C	Set 7	3Ø 75 Cu 3 PH
Enter Amps	2 6 0 Amps	AMPS 260.
Find wire size	WireSz	AWG 300 CU WIRE SIZE
Change to 90˚	Set 9	AWG 0000 CU WIRE SIZE
Reset to 60˚ and Clear	Set 6 On/C	3Ø 60 Cu 0.

Wire Sizing Based on Ambient Temperature

Find the 90°C copper wire size needed to connect a 47,700 Volt-amp load to a 240 Volt, single-phase source. What is the adjusted wire size, if the ambient temperature rating is changed from the default 30°C to 40°C?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Set to 90°C	Set 9	1Ø 90 Cu 1 PH
Enter VA	4 7 7 0 0 VA	VA 47,700.

(Cont'd)

(Cont'd)

Steps	Keystrokes	Display
Enter Volts	2 4 0 Volts	VOLT 240.
Find Amps	Amps	AMPS 198.75
Find wire size	WireSz	AWG 000 CU WIRE SIZE
Change ambient temperature	2 0 Set 2	AMB° 20.˚C
Find adjusted wire size	WireSz	AWG 00 CU Amb WIRE SIZE
Display Wire Ampacity	WireSz	00 202.8 Amb WIRE A
Display CMIL	WireSz	CMIL 133,100. WIRE
Display NEC Table	WireSz	NEC 310.16
Reset ambient temperature	3 0 Set 2	AMB° 30.˚C

NOTE: *See "Settings" on page 62 for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Wire Sizing Based on Material Type

Find the wire size for a 75°C copper wire carrying a 3Ø load of 265 Amps. What is the equivalent aluminum wire size?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Set to 75°C	Set 7	3Ø 75 Cu 3 PH
Enter Amps	2 6 5 Amps	AMPS 265.
Find wire size	WireSz	AWG 300 CU WIRE SIZE
Change to alum.	Set 4	AWG 400 AL WIRE SIZE
Display Wire Ampacity	WireSz	400 270.0 Al WIRE A
Display CMIL	WireSz	CMIL 400,000 WIRE
Display NEC Table	WireSz	NEC 310.16
Reset to copper and Clear	Set 4 On/C	3Ø 75 Cu 0.

NOTE: *See "Settings" on page 62 for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Sizing Parallel Conductors

What size 60°C insulated copper wire is required for a single conductor carrying a 500 Amp load in a Free Air environment (30°C amb. temp.)? What size for 2 parallel conductors? For 3 conductors?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 60°C	Set 6	3Ø 60 Cu 0
Set free air mode	Set 5	3Ø 60 FrAir Cu 0.
Enter Amps	5 0 0 Amps	AMPS 500.
Find 1 wire size	WireSz	AWG 500 CU FrAir WIRE SIZE
Find 2 wire size	2 ParSz	PAR 000 CU FrAir WIRE SIZE
Find 3 wire size	3 ParSz	PAR 0 CU FrAir WIRE SIZE
Exit Free Air Mode and Clear	Set 5 On/C	3Ø 60 Cu 0.

NOTE: *Parallel wire sizes smaller than 1/0 will be displayed as nonE.*

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding Derated Wire Size

What is the derated wire size required for nine 75°C copper wires, each carrying a maximum load of 65 Amps?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 75°C	Set 7	3Ø 75 Cu 0.
Enter Amps	6 5 Amps	AMPS 65.
Find normal wire size	WireSz	AWG 6 CU WIRE SIZE
Find derated wire size	9 Set ParSz	D/R 3 CU WIRE SIZE
Display Wire Ampacity	ParSz	D/R 45.5 WIRE A
Display Adjustment Factor	ParSz	ADJ 70. %
Display NEC Table	ParSz	NEC 310.15

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Sizing Temperature-Adjusted Derated Wires

A circuit was built with 60°C copper wire connecting a 47,650 Volt-amp load to a 240 Volt, three-phase source. Ambient temperature is 50°C. What is the derated wire size required if eight current-carrying THHN wires were installed in the raceway?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 60°C	Set 6	3Ø 60 Cu 0.
Enter Volt-amps	4 7 6 5 0 VA	VA 47,650.
Enter Volts	2 4 0 Volts	VOLT 240.
Set to 50°C amb	5 0 Set 2	AMB° 50. °C
Find adj. wire size	WireSz	AWG 250 CU Amb WIRE SIZE
Find derated wire size	8 Set ParSz	D/R 500 CU Amb WIRE SIZE
Display Wire Ampacity	ParSz	D/R 46.5 Amb WIRE A
Display Adjust. Factor	ParSz	ADJ 41. % Amb
Display NEC Table	ParSz	NEC 310.15
Set to 30°C and Clear	3 0 Set 2 On/C	0.

NOTE: *All Settings should be changed back to default to avoid conflicts in answers throughout the rest of this manual. See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Voltage Drop

The reduction in Voltage between the power source and the load can be determined by entering the Phase, Volts, Amps, wire material, Voltage drop wire size and length of run. The calculator determines resistance and then the Voltage reduction. Voltage drop can be displayed as Volts dropped, or as a percent reduction of potential load.

This calculator also finds Voltage drop wire size once you have entered or calculated the phase, Volts, Amps, Length, wire type, and allowable VD percentage. It will solve for the distance (**Length**) once you have entered or calculated the phase, Volts, Amps, wire type, Voltage drop wire size, and allowable VD percentage. The *ElectriCalc Pro* uses resistance values found in NEC Table 8 Chapter 9 to determine Voltage drop.

NOTE: *Voltage drop solutions may vary slightly from actual AC circuit measurements as the calculator does not incorporate factors such as inductive reactance, skin effect, raceway material, etc. In most situations, the DC Voltage Drop calculation is sufficient to meet safety standards.*

IMPORTANT NOTE ON VOLTAGE DROP CALCULATIONS

The *ElectriCalc Pro* calculates Voltage drop and wire size using DC resistance as defined by the 2005 NEC. To find the Voltage drop for a *specific* wire size, you must *first enter Amps and the one-way wire Length* (and other required variables), entering the specific wire size *last*.

Otherwise, for your safety the calculator will recalculate the wire sizes based on the '99 NEC Ampacity Tables and maximum allowable Voltage drop.

Finding Single-Phase Voltage Drop

You are installing 175 Feet of 75°C, #8 THW branch circuit copper conductors to supply an 11A load on a 208V 1Ø system. What is the source Voltage drop at the load?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Set to 75°C	Set 7	1Ø 75 Cu 1 PH
Enter Amps	1 1 Amps	AMPS 11.
Enter Volts	2 0 8 Volts	VOLT 208.
Enter Length	1 7 5 Length	FEET 175.
Enter wire size*	8 WireSz	AWG 8 CU WIRE SIZE
Solve volt. drop	VD%	DROP 3.0 V
Solve % v.drop	VD%	DROP 1.4 V %

** Wire size can also be entered in Circular Mils (e.g., 1 6 5 1 0 WireSz enters 16,510 CMILs and displays 8 AWG wire size).*

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding Three-Phase Voltage Drop

A 20 Amp, three-phase load is being fed by a 230 Volt source located 150 Feet away. The installation specifications require 75°C #10 THW stranded copper conductor. What is the Voltage drop on this branch circuit?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 75°C	Set 7	3Ø 75 Cu 0.
Set to 3-phase	Set 3	3Ø 75 Cu 3 PH
Enter Amps	2 0 Amps	AMPS 20.
Enter Volts	2 3 0 Volts	VOLT 230.
Enter Length(feet)	1 5 0 Length	FEET 150.
Find VD wire size	WireSz	AWG 10 CU VD WIRE SIZE
Solve volt. drop	VD%	DROP 6.4 V
Solve % v.drop	VD%	DROP 2.8 V %

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding Voltage Drop Wire Size

A 20 Amp, three-phase 208 Volt load will be located 175 Feet away from the source. Assuming a 3% allowable Voltage drop, what is the size of 75°C conductor required for this branch circuit?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 75°C	Set 7	3Ø 75 Cu 0.
Enter Amps	2 0 Amps	AMPS 20.
Enter Volts	2 0 8 Volts	VOLT 208.
Enter distance	1 7 5 Length	FEET 175.
Enter allow. VD%	3 VD%	DROP 3.0 V %
Find wire size	WireSz	AWG 8 CU VD WIRE SIZE
Find actual Voltage drop	VD%	DROP 4.7 V
Find % v.drop	VD%	DROP 2.3 V %

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding Voltage Drop Distance

How far from a three-phase 240 Volt source can you install a 15 Amp load using 60°C #10 copper branch circuit conductors? Assume a 3% allowable Voltage drop.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 60°C	Set 6	3Ø 60 Cu 0.
Enter Amps	1 5 Amps	AMPS 15.
Enter Volts	2 4 0 Volts	VOLT 240.
Enter wire size*	1 0 WireSz	AWG 10 Cu WIRE SIZE
Enter 3% VD	3 VD%	DROP 3.0 V %
Find distance	Length	FEET 234.86987
Find actual Voltage drop	VD%	DROP 7.2 V
Find % v.drop	VD%	DROP 3.0 V %

** Wire size can also be entered in Circular Mils (e.g., 1 0 3 8 0 WireSz enters 10,380 CMILs and displays 10 AWG wire size).*

NOTE: *The calculator automatically makes adjustments for resistance using NEC Chapter 9, Table 8, if the insulation type is other than 75°C.*

See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.

Finding Voltage Drop Resistance

What is the resistance of 85 Feet of #2 90°C copper conductor?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 90°C	Set 9	3Ø 90 Cu 0.
Enter wire size*	2 WireSz	AWG 2 CU WIRE SIZE
Find resistance	Set Length	OHMS 0.2033993 WIRE
Find 85 ft resist**	÷ 1 0 0 0 X 8 5 =	0.0172889

** Wire size can also be entered in Circular Mils (e.g., 6 6 3 6 0 WireSz enters 66,360 CMILs and displays 2 AWG wire size).*

***Given resistance per 1000 Feet, divide by 1000 to get a per Foot resistance, then multiply by 85.*

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding DC Resistance

What is the equivalent resistance of a 12 Volt DC circuit pulling 5 Amps?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter Voltage	1 2 Set Volts	Vdc 12.
Enter Amps	5 Set Amps	Idc 5.
Find resistance	Set VA	OHMS 2.4

Ground Conductor Wire Size

You can use single or multiple service entrance conductor(s) to find the grounding electrode conductor for AC systems. When using multiple conductors, the *ElectriCalc Pro* uses the equivalent Circular Mils to find the grounding electrode conductor (based on NEC Table 250-66).

Find the grounding electrode conductor wire size required when 2/0 is the largest 3-phase 75°C copper service-entrance conductor being used. What is the equivalent aluminum size? What is the equivalent Circular Mils?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Set to 75° C	Set 7	3Ø 75 Cu 3 PH
Enter wire size*	0 0 WireSz	AWG 00 CU WIRE SIZE
Find ground wire size	Grnd	GRND 4 CU WIRE SIZE
Find aluminum size	Grnd	GRND 2 AL WIRE SIZE
Find Circular Mils	Grnd	CMIL 133,100. WIRE
Display NEC Table	Grnd	NEC 250.66

** Wire size can also be entered in Circular Mils (e.g., 1 3 3 1 0 0 WireSz enters 133,100 CMILs and displays 00 AWG wire size).*

Equipment Grounding Conductor Wire Size

The **Set** **Grnd** keystroke can be used to find the grounding conductor size for raceways and "over-current devices in circuit ahead" equipment. The calculator uses the displayed amperage value to solve for the equipment grounding conductor based on NEC Table 250-122.

Find the equipment grounding conductor size required when the circuit-breaker is rated at 45 Amps and 90° copper is being used in the installation. What is the equivalent aluminum size?

Steps	Keystrokes	Display
Clear calculator	**On/C** **On/C**	0.
Set to 90º C	**Set** (9)	3Ø 90 Cu 0.
Enter Amp rating	(4) (5) **Amps**	AMPS 45.
Find equipment ground wire size	**Set** **Grnd**	EQPG 10 CU WIRE SIZE
Find aluminum size	**Grnd**	EQPG 8 AL WIRE SIZE
Display NEC Table	**Grnd**	NEC 250.122
Reset to 60˚C and Clear	**Set** (6) **On/C**	3Ø 60 Cu 0.

Fuse and Circuit Breaker Size

What is the calculated dual element and single element fuse size for a 230 Volt, 3-phase, 50 HP induction motor? What are the Instantaneous Trip and Inverse Time Circuit Breaker requirements?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter Volts	2 3 0 Volts	VOLT 230.
Enter HP	5 0 HPmotor	IND 50. HP
Find full current	Amps	FLC 130. A
Find DE fuse size	DEFuse	AMPS 227.5 dE
Display % used	DEFuse	%FLC 175.
Find SE fuse size	Set DEFuse	AMPS 390. SE
Display % used	DEFuse	%FLC 300.
Find inv. time brkr	InvTime	AMPS 325. b2
Display % used	InvTime	%FLC 250.
Find ins. trip breaker size	Set InvTime	AMPS 1,040. b1
Display % used	InvTime	%FLC 800.

Starter Size

What NEMA size starter is required for a 575 volt, 3Ø, 20 HP induction motor?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter Volts	5 7 5 Volts	VOLT 575.
Enter HP	2 0 HPmotor	IND 20. HP
Solve for starter size	Set HPmotor	STAR 2 SIZE

Overload Protection Size

What overload protection device size is required for a 460 Volt, 3-phase, 15 HP induction motor with a nameplate current rating of 19.2 Amps and a 1.0 service factor? What is the required overload rating at 125% (for a 1.15 service factor)?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 3-phase	Set 3	3 PH
Enter Volts	4 6 0 Volts	VOLT 460.
Enter Horsepower	1 5 HPmotor	IND 15. HP
Enter nameplate current	1 9 • 2 Amps	AMPS 19.2
Find overload size	O-Load	AMPS 22.08 ol
Display % used	O-Load	%FLC 115.
Find 125% load	1 2 5 O-Load	AMPS 24. ol
Display % used	O-Load	%FLC 125.
Reset overload rating and clear	1 1 5 O-Load On/C	0.

Conduit Size

The *ElectriCalc Pro* can calculate the size of conduit required when running single or multiple wires using the **CondSz** key and the calculator's internal tables. The calculator uses NEC values for area of THW/THHW, XHH/XHHW, and THHN/THWN wires. When using the actual wire areas (and following the guidelines in NEC Chapter 9, Tables 1, 3, 4 and 5), the calculator can calculate a conduit size based on the conduit type and the same or different wire types and sizes.

To select a specific conduit type, enter the corresponding number of the conduit and then press **Set** **CondSz**. The numbers and types are:

1) EMT 2) ENT 3) FMC 4) IMC
5) LFNB 6) LFNA 7) LFMC 8) RMC
9) P-80 10) P-40 11) P-A 12) P-EB

When you enter a new conduit type or scroll through the types, you will see the updated conduit size (if you have entered the wire type and quantity).

Finding Motor Branch-Circuit Wire Size and Conduit Size — Same Wire Type & Size

What size THHN copper wire and RMC conduit are needed to connect a 10 HP 1Ø induction motor to a 115 Volt source?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 1-phase	Set 1	1 PH
Set to 60° C	Set 6	1Ø 60 Cu 1 PH
Enter Volts	1 1 5 Volts	VOLT 115.
Enter Horsepower	1 0 HPmotor	IND 10. HP
Enter cond. type	8 Set CondSz	RMC nonE
Display full load Amps	Amps	FLC 100. A
Find wire size	Set WireSz	AWG 0 CU
		WIRE SIZE 125%
Find wire ampacity	WireSz	0 125.0*
		WIRE A125%
Find conduit size	CondSz	RMC 1.25 in
		COND SIZE
Find total # wires	CondSz	2. TTL WIRES
Find conduit fill %	CondSz	FILL 24.3
		COND %
Find act. fill area	CondSz	FILL 0.3710
		TTL WIRE AREA
Find rem. area	CondSz	REM 0.1021
		WIRE AREA
Set to 3-phase and Clear	Set 3 On/C	3Ø 60 Cu 0.

** If a wire size has been calculated or stored, and the wire type/quantity is not defined, the calculator will assume 2 THHN wires for 1Ø and 3 THHN wires for 3Ø when calculating conduit size. Display will also show wire size in upper left when displaying maximum ampacity rating.*

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Finding Conduit Sizes for Multiple Conductors — Same Wire Type and Size

Find the minimum IMC conduit size for eleven #6 THHN copper wires.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter cond. type	4 Set CondSz	IMC nonE
Enter wire size*	6 WireSz	AWG 6 CU WIRE SIZE
Enter # THHN	1 1 #THHN #THWN	THHN 11. WIRES
Find conduit size	CondSz	IMC 1.25 in COND SIZE

** Wire size can also be entered in Circular Mils (e.g., 2 6 2 4 0 WireSz enters 26,240 CMILs and displays 6 AWG wire size).*

Finding Number of Wires in Existing Conduit — Same Size, Various Types

Find the maximum number of #10 THHN copper wires that can be pulled through an existing 3 Inch EMT conduit. How many XHHW wires? How many THW wires?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter cond. type	1 Set CondSz	EMT nonE COND
Enter wire size*	1 0 WireSz	AWG 10 CU WIRE SIZE
Enter conduit size	3 CondSz	EMT 3.00 in COND SIZE
Find max THHN #	#THHN #THWN	THHN 167. TTL WIRES
Find max XHHW#	#XHH #XHHW	XHHW 145. TTL WIRES
Find max THW #	#THW #THHW	THW 145. TTL WIRES

** Wire size can also be entered in Circular Mils (e.g., 1 0 3 8 0 WireSz enters 10,380 CMILs and displays 10 AWG wire size).*

Finding Conduit Size - Multiple Conductors Different Wire Sizes and Types

Three 1/0 THWN 75°C conductors and one #2 XHHW 75°C copper conductor are to connect to a panel board using a single conduit. What is the cross-sectional area of wires, conduit size and actual fill area? *(Note: The cross-sectional areas are the same for both THHN and THWN; display will show as THHN.)*

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Set to 75°	Set 7	3Ø Cu 75 0.
Enter cond. type	3 Set CondSz	FMC nonE COND
Enter 1st wire sz*	0 WireSz	AWG 0 CU WIRE SIZE
Enter #, type wire	3 #THHN #THWN	THHN 3. WIRES
Find cross-section wire area	#THHN #THWN	THHN 0.5565 WIRE AREA
Enter 2nd wire sz*	2 WireSz	AWG 2 CU WIRE SIZE
Enter #, type wire	1 #XHH #XHHW	XHHW 1. WIRE
Find cross-sect.	#XHH #XHHW	XHHW 0.1146 WIRE AREA
Find conduit size	CondSz	FMC 1.50 in COND SIZE

(Cont'd)

(Cont'd)

Steps	Keystrokes	Display
Find total # wires	CondSz	4. TTL WIRES
Find conduit fill %	CondSz	FILL 36.1 COND %
Find actual fill area	CondSz	FILL 0.6711 TTL WIRE AREA
Find remaining area	CondSz	REM 0.0717 WIRE AREA

** Wire size can also be entered in Circular Mils (e.g., 1 0 5 6 0 0 WireSz enters 105,600 CMILs and displays 0 AWG wire size; 6 6 3 6 0 WireSz enters 66,360 CMILs and displays 2 AWG wire size).*

NOTE: *See "Settings" for a list of Permanent Values/settings. Changing these settings may affect your calculations.*

Converting KW-HR and BTU

Find the equivalent BTU rating of a 3.5 kw-hr rated furnace.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter Kilowatt Hours	3 • 5	3.5
Find Equivalent BTU	Set •	BTU 11,953.552

What is the kw-hr rating for a 4,500 BTU heater?

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter BTU Rating	4 5 0 0	4,500.
Find Equivalent Kilowatt Hours	Set =	KW-H 1.3176

Parallel Resistance

Find the equivalent resistane for 10 Ohm, 20 Ohm, and 50 Ohm resistors placed in parallel.

Steps	Keystrokes	Display
Clear calculator	On/C On/C	0.
Enter 1st Resistor	1 0 Set Stor	P-RS 10.
Enter 2nd Resistor	2 0 Set Stor	P-RS 6.6666667
Enter 3rd Resistor	5 0 Set Stor	P-RS 5.8823529

NOTE: *The total is recalculated with each additional resistor value entered.*

Error Codes

The error codes for the *ElectriCalc Pro* are listed below (Note: To clear an error, perform a Clear All **Set** **X**):

DISPLAY	ERROR DESCRIPTION
OFLO	Answer too large to display
ENT Error	Invalid or out-of-scale entry
POWR Error	PF or EFF calculated above 100%
nonE	Conduit Size beyond limits of table
	Unable to calculate Voltage Drop wire Size*(Amps/Length too high)*
	Temperature setting out of range for wire calculation.
HP Error	Invalid HP entry per NEC table
FULL Error	Entered or calculated more than 15 different wires sizes
EROM Error	Bad EROM
MATH Error	Math error (i.e., divide by zero)

Battery Information

The calculator is powered by a single 3-Volt Lithium CR-2032 battery. This should last upwards of 800 hours of actual use (One year plus for most people). If the display becomes very dim or erratic, replace the battery.

NOTE: *Please use caution when disposing of your old batteries as they contain hazardous chemicals.*

Battery Replacement Instructions:

1) Hold calculator upright with back of calculator toward you.

2) Lift battery holder out from the top of the calculator.

3) Remove the old battery.

4) Place new battery with positive side against the bottom of the holder.

5) Insert holder into calculator with positive side of battery facing back of calculator.

2005 NEC References

Table 250.66
Table 250.122
Table 310.15(b)(2)(a)
Table 310.16
Table 310.17
Chapter 9, Table 1, 4, 5 and 8
Section 430.32
Table 430.148
Table 430.150
Table 430.152
Appendix C

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All listed table references are based on NEC 2005. Previous code years may have different table references.

Updating Future Code Revisions

This model is updateable for future NEC Editions. For information on future codes, contact the dealer where this calculator was purchased or you may contact Calculated Industries, Inc. in the fall of the year prior.

Settings

Permanent Values/Settings

Values and settings maintained in permanent Memory can only be changed (1) by pressing **Set** **X** (resets calculator to default settings), or (2) by changing each one or all of these settings. The following are permanent values:

(1) Selectable (60°C/75°C/90°C) insulation ratings and CU/AL wire type ratings

(2) Phase setting (1Ø/3Ø)

(3) The entered values for Volts, Voltage Drop %, Power Factor % and Efficiency %

(4) Ambient Temperature setting

Semi-Permanent Values

The following semi-permanent values are cleared to default settings when the calculator is shut-off:

(1) Cumulative Memory (M+)

(2) Free Air mode

Repair and Return

Return Guidelines

1. Please read the ***Warranty*** in this User's Guide to determine if your Calculated Industries product remains under warranty **before** calling or returning any device for evaluation or repairs.

2. If your product will not turn on, check the battery as outlined in the User's Guide.

3. If you need more assistance, please go to the website listed below.

4. If you believe you need to return your product, please call a Calculated Industries' representative between the hours of 7:00am and 4:00pm Pacific Time for additional information and a Return Merchandise Authorization (RMA).

Call Toll Free: 1-800-854-8075

Outside USA: 1-775-885-4900

www.calculated.com/warranty

Warranty Repair Service – U.S.A.

Calculated Industries ("CI") warrants this product against defects in materials and workmanship for a period of **one (1) year from the date of original consumer purchase in the U.S.** If a defect exists during the warranty period, CI, at its option, will either repair (using new or remanufactured parts) or replace (with a new or remanufactured calculator) the product at no charge.

THE WARRANTY WILL NOT APPLY TO THE PRODUCT IF IT HAS BEEN DAMAGED BY MISUSE, ALTERATION, ACCIDENT, IMPROPER HANDLING OR OPERATION, OR IF UNAUTHORIZED REPAIRS ARE ATTEMPTED OR MADE. SOME EXAMPLES OF DAMAGES NOT COVERED BY WARRANTY INCLUDE, BUT ARE NOT LIMITED TO, BATTERY LEAKAGE, BENDING, A BLACK "INK SPOT" OR VISIBLE CRACKING OF THE LCD, WHICH ARE PRESUMED TO BE DAMAGES RESULTING FROM MISUSE OR ABUSE.

To obtain warranty service in the U.S., please go to the website.

A repaired or replacement product assumes the remaining warranty of the original product or 90 days, whichever is longer.

Non-Warranty Repair Service – U.S.A.

Non-warranty repair covers service beyond the warranty period, or service requested due to damage resulting from misuse or abuse.

Contact Calculated Industries at the number listed above to obtain current product repair information and charges. Repairs are guaranteed for 90 days.

Repair Service – Outside U.S.A.

To obtain warranty or non-warranty repair service for goods purchased outside the U.S., contact the dealer through which you initially purchased the product. If you cannot reasonably have the product repaired in your area, you may contact CI to obtain current product repair information and charges, including freight and duties.

Disclaimer

CI MAKES NO WARRANTY OR REPRESENTATION, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT'S QUALITY, PERFORMANCE, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. AS A RESULT, THIS PRODUCT, INCLUDING BUT NOT LIMITED TO, KEYSTROKE PROCEDURES, MATHEMATICAL ACCURACY AND PREPROGRAMMED MATERIAL, IS SOLD "AS IS," AND YOU THE PURCHASER ASSUME THE ENTIRE RISK AS TO ITS QUALITY AND PERFORMANCE. IN NO EVENT WILL CI BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECT IN THE PRODUCT OR ITS DOCUMENTATION.

The warranty, disclaimer, and remedies set forth above are exclusive and replace all others, oral or written, expressed or implied. No CI dealer, agent, or employee is authorized to make any modification, extension, or addition to this warranty.

Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.

FCC Class B

This equipment has been certified to comply with the limits for a Class B calculating device, pursuant to Subpart J of Part 15 of FCC rules.

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4840 Hytech Drive
Carson City, NV 89706 U.S.A.
1-800-854-8075 • Fax: 1-775-885-4949
E-mail: info@calculated.com
www.calculated.com

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